The effect of low-magnitude high-frequency loading on peri-implant bone healing and implant osseointegration in beagle dogs

論 文 内 容 要 旨

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Abstract

Objectives

The low-magnitude high-frequency (LMHF) loading is known to play an important role in bone healing. However, its direct effect on peri-implant bone osteogenesis is still not clear. This study aimed to evaluate the effect of the LMHF loading, applied directly to the implant, on peri-implant bone healing and implant osseointegration.

Methods

The mandibular premolars and molars of 6 male beagle dogs with an average weight of 12.5 ± 2.45 kg were extracted. After 3 months, 36 Ti implants (Aadva Standard implant Narrow, Φ3.3 X 8mm, GC, Japan) were inserted into the mandibular premolar and molar area of 6 male beagle dogs. The healing screws (Healing screws Narrow EPH4.0, Φ4.0 X H6.0 mm, GC, Japan) were then used to cover the implants. For every animal, one side with 3 implants was selected randomly as treatment group to applied LMHF loading daily, while the other was not (control). The loading was applied directly to the implant abutment using by an individual jig and a custom made loading device (8 μm, 100 Hz). Implant stability quotient (ISQ) value was tested every week. The six dogs were sacrificed half and half 2 weeks and 8 weeks respectively. The tissue samples were fixed and stained for Micro-CT analysis and histomorphometraical analyses. Data were analyzed statistically with the significance set at $P < 0.05$.

Results

The most of ISQ value was slightly decreased after 1 or 2 weeks, and then increased gradually. The treatment group tended to have a greater ISQ value than the control group from the beginning to the end of the study period (except at 8 weeks), but these intergroup differences were not significant. In 2 weeks, the diverse was more apparently then that in 8 weeks.

The Micro-CT analysis showed that there were no significant differences between the control and treatment groups in the relative gray value at any location. However, after 2 weeks of loading, the relative gray value for all parameters tended to be greater in the treatment group than the control group. Histological images of 2-weeks healed implants clearly showed an osteogenic reaction around the implants, particularly in the loading group. After four weeks of healing, the immature bone around the implant reorganized and became much denser. The histomorphometric results revealed that the BV/TV in ROI2 was significantly higher in the treatment group compared with the control group after 2 weeks of loading ($p < 0.05$). Although there were no significant differences between groups in the other histomorphometric results, all the parameters in the treatment group tended to be greater than those in the control group after 8 weeks of loading.

Conclusions

LMHF loading positively influenced peri-implant bone healing in the early healing period.